N00129.AR.000023
NSB NEW LONDON
5090.3a

Radiological Assessment

U.S. Naval Submarine Base
Groton, Connecticut

September 18, 1990

Prepared for:

Atlantic Environmental Services, Inc.
188 Norwich Avenue
Post Office Box 297
Colchester, Connecticut

Prepared by:

RADIATION SAFETY ASSOCIATES, INC.
10 Pendleton Drive
Post Office Box 107
Hebron, Connecticut
(203) 228-0487

SCOPE

Radiation Safety Associates, Inc. (RSA) of Hebron, Connecticut was engaged by Atlantic Environmental (AE) of Colchester, Connecticut to perform a radiological survey of three areas of the U.S. Naval Submarine Base in Groton, Connecticut. The three areas surveyed were the "Area 'A' Landfill," "Goss Cove" (USS Nautilus exhibit), and the "DPDO" area. The purpose of these surveys was to determine if any radioactive material had been disposed of there, or if any radioactive contamination now exists at any of these locations. Surveys were carried out on June 27, July 10, and August 8, 9, and 17, 1990 by Richard Pert and Paul R. Steinmeyer. Survey methods and results were reviewed and approved by K. Paul Steinmeyer. Their resumes are Appendix A to this report.

INSTRUMENTATION

The gamma radiation surveys were performed using a solid-state, one-inch by one-inch sodium iodide detector in a Model 19 Micro-R meter, manufactured by Ludlum Measurements of Sweetwater, Texas. This instrument is sensitive only to gamma radiation and reads in units of micro Roentgens per hour (μR/hr) or millionths of a Roentgen per hour. This is a very sensitive detector in general use for environmental surveys such as are described in this report, and is a state-of-the-art instrument. This was the primary instrument used for the radiological survey of the sites.

Beta radiation surveys were performed using a 2-inch diameter (approximately 20 square centimeter) Geiger-Mueller, thin entry window, pancake type, Ludlum Model 44-9 detector. This was connected to a Ludlum Model 18 count rate meter. This detection system is sensitive to beta and gamma radiation, but will also detect alpha particles which have energies over 3 MeV.

Alpha radiation surveys were performed using a 4-inch diameter (approximately 80 square centimeter) Model 43-1 detector with a Model 18 count rate meter, both manufactured by Ludlum Measurements. This detector is sensitive only to alpha radiation, and does not respond to beta or gamma radiation. During surveys, the detector was held within one centimeter of the surface being surveyed. This is necessary due to the very short range of alpha particles in air (approximately 7 cm).

Low-energy gamma measurements were taken using a 1-inch diameter Model 44-3 detector with a Model 18 count rate meter, both manufactured by Ludlum Measurements. This detector is sensitive to low-energy gamma radiation, which may not be detected with the Micro-R meter. It does not respond to the higher energy gamma rays which the Micro-R meter detects.

Calibration certificates for all of these instruments are in Appendix B to this report.

SURVEY METHOD

A survey map of each area to be assessed was obtained from AE. Stakes had previously been placed in each area by AE approximately every 50 feet on lines approximately 50 feet apart. The gamma radiation survey consisted of walking back and forth on each line of stakes, and also half-way between each line of stakes, recording gamma levels at or parallel to each marker, and at the approximate midpoint between each marker. Measurements at each survey point consisted of one gamma reading at waist level and another in contact with the ground. Additionally, a continuous survey was performed while walking between each survey point. Maps identifying the survey points and tables showing measurements taken at each location are Appendices C (Area "A" Landfill), D (Goss Cove), and E ("DPDO") to this report.

Background gamma radiation levels were taken outside the perimeters of each area surveyed and at other randomly selected locations around the Base. Any gamma measurement in the survey areas found to be significantly in excess of background gamma levels (see below) was investigated further by attempting to determine the specific origin of that radiation, and by performing alpha and beta radiation surveys in those areas.

SURVEY FINDINGS

Background Radiation

Measurements of background radiation were taken outside the perimeter of each area surveyed as well as in several random locations around the Base, such as on the golf course (at the corner of Shark Avenue and Wahoo Avenue), at the corner of Thesher Avenue and Corsair Avenue, and at the corner of Crystal Lake Road and the Military Highway. Background gamma radiation measured between 12 and 15 μR/hr in all these locations. Background beta radiation in all locations measured 60-80 counts per minute. BAckground alpha readings were 1-2 counts per minute. These levels are well within what is considered "normal" for this region. Any gamma reading of 20 μR/hr or more in the survey areas was investigated further.

A gamma radiation reading of 20 μR/hr or more was used as a trigger point at which further surveys and evaluations were performed.

Area "A" Landfill

Out of 1,272 measurements taken in the Area "A" Landfill, fourteen survey points were found to have gamma readings equal to or greater than 20 μR/hr. These points were investigated further to determine the origin of the radiation in excess of background.

Location 8.5-E (see Appendix C) showed 21 μR/h at waist level and 19 μR/hr in contact with the ground. These levels were traced to a natural rock outcropping in that area. Most rock in New England contain some traces of naturally-occurring uranium, radium, and thorium; finding individual rocks or rock formations with detectable amounts of radiation is not at all unusual and is not indicative of any radioactive contamination.

The following 11 survey points were all located in the section of the landfill containing sandbags piled on wooden pallets: 11.5-A/B, 11.5-B, 11.5-B/C, 11.5-C, 12-B, 12-B/C, 12.5-B, 13.5-B, 13.5-B/C, 13.5-C, and 14-B/C. The readings at these points ranged from 14 μR/hr (location 12.5-B at waist level) to 30 μR/hr (11.5-B/C on contact with the ground).

When technicians returned to perform followup surveys at these locations, the sandbags within an approximately 40 foot diameter around survey points 11.5-B/C had been removed. Gamma readings at this point were 15 μR/hr contact with the ground, in sharp contrast to the previously-recorded 30 μR/hr. This indicates that the slightly elevated readings in this area are caused by the sandbags (sand, like rock, may contain trace amounts of naturally-occurring radioactive materials). To further test this theory, a gamma measurement of 24 μR/hr was taken on the ground at location 12-B/C (within the sandbag area). The sandbags were then removed from an approximately five foot diameter around this survey point. This reduced the radiation level to 19 μR/hr. This is further evidence that the slightly elevated gamma readings were caused by the sandbags. No beta or alpha radiation in excess of background levels was detected.

Four samples of sand (from locations 11.5-B/C, 12-B/C, 13.5-B/C, and 14-B/C) were taken back to the RSA office for evaluation. The results of this analysis are shown in the table below. All readings are reported in units above background levels.

		Probe/Instrument Type			
Sample #	Location	44-9 (β)	43-1 (α)	44-3 (γ)	Micro-R (γ)
1	11.5-B/C	22 cpm	9 cpm	26 cpm	bkg.
2	12-B/C	15 cpm	6 cpm	bkg.	bkg.
3	13.5-B/C	35 cpm	6 cpm	bkg.	bkg.
4	14-B/C	21 cpm	5 cpm	bkg.	1 μR/hr
Background Levels		32 cpm	1 cpm	200 cpm	6 μR/hr

The readings in the above table indicate that there is some small amount of radioactive material in the sand, probably naturally-occurring.The four samples were then combined and sent to the NDL Organization for a more precise analysis. This analysis consisted of a gross alpha count, a gamma spectrum analysis for isotope identification, and a determination of specific activity. The analysis showed that only naturally occurring radionuclides were present; no "contamination" was indicated. While this small sample is below the lower limit of detection for gamma radiation, it can be concluded that the volume of sand present at the landfill would contribute to the slightly elevated readings. The report from NDL is included as appendix F to this report.

The other locations within the sandbag area showing slightly elevated gamma levels (and the areas around them) were re-surveyed, and no specific "hot" area could be located; the entire sandbag area showed a tendency towards slightly elevated readings.
Based on all of the measurements described above, we conclude that the sandbags themselves are the source of the nominally higher gamma levels, and not any man-made contamination or buried radioactive materials.

Location 13.5-F showed 19 μR/hr at waist level and 28 μR/hr on contact with the ground. This measurement was taken near a pile of cut granite which was determined to be the source of the elevated readings. Gamma measurements taken from within the rock pile showed 55 μR/hr; after removing the rocks from an area approximately 16 inches in diameter from that location, the center showed only 25 μR/hr, a reduction of 30 μR/hr. Beta measurements from within the rockpile showed 120 cpm; the area where the rocks were removed showed only 80 cpm (background). Granite is especially notorious for containing naturally-occurring radioactive materials. We are therefore confident that the elevated levels in this location are emanating from the rock pile and not from any buried radioactive material.

Location 27-E/F showed 20 μR/hr at waist level and 19 μR/hr in contact with the ground. This measurement, however, was taken at the base of a very large rock outcropping, and was apparently caused by naturally occurring radioactive materials within the rock.

Goss Cove (U.S.S. Nautilus)
At Goss Cove 458 measurements were made. All were well within what is considered normal background radiation for this region. The highest reading was at location F/G-14, which showed 16 μR/hr at waist level and 19 μR/hr in contact with the ground. This location is near the base of a granite cliff, which would account for the slightly elevated gamma measurement. No readings in this area exceeded the 20 μR/hr investigation level.

DPDO
In the DPDO area 372 measurements were made. All were well within what is considered normal background radiation for this region. No measurement in this area exceeded 17 μR/hr.

CONCLUSIONS AND RECOMMENDATIONS

All three areas were subjected to extensive surface radiation surveys. We found no gamma radiation levels in excess of 20 μR/hr which could not be accounted for by obvious sources of naturally-occurring radioactive material. This leads us to conclude that there are no large quantities of gamma-emitting radioactive material buried in the areas surveyed.

However, it should be noted that asphalt covers most of the Goss Cove and DPDO areas, and portions of the Landfill area. Asphalt has some shielding properties, and the possibility exists that radioactive materials buried under the asphalt may have gone undetected. We therefore recommend that, as a precaution, a representative sample of any sub-surface samples taken from under asphalt be screened for radioactivity.

_____

Paul R. Steinmeyer Date
Health Physics Technician

_____

Richard E. Pert Date
Health Physicist

_____

K. Paul Steinmeyer, RRPT Date
Health Physicist

Appendix A-1
Curriculum Vitae

K. PAUL STEINMEYER

EDUCATION AND TRAINING

U.S. Naval Nuclear Power School and Prototype Training

Submarine School

Various Navy Courses in Electronics and Instrumentation

Bachelor of Arts (Honors), University of Connecticut

"Radiological Controls," Naval Reactor Prototype, Windsor, Connecticut

"Radiation Protection Surveys," University of Michigan

"Radiation Protection Technology--Phase I," Northeast Utilities, Berlin, Connecticut

"Radiation Protection Technology--Phase II," Northeast Utilities, Berlin, Connecticut

Various University Courses in Mathematics, Statistics, Metallurgy, and Radiochemistry

Factory-Authorized Service Training on SCBA Regulators, Mine Safety Appliances Company, Pittsburgh, Pennsylvania

Factory-Authorized Service Training on SCBA Regulators, Scott Aviation, Lancaster, New York

EXPERIENCE

1981 to Present

President, Radiation Safety Associates, Inc. Provide consulting, training and technical services in health and safety matters on a nationwide basis to the nuclear industry, general industry, local, state and the federal government, and academic institutions. Special emphasis is given to the areas of respiratory protection, radiation safety, asbestos abatement, hazmat response and health physics. Editor of *Radiation Protection Management*, the Journal of Applied Health Physics. Founder and Editor of *Respiratory Protection Newsletter* (formerly *Radiological Respiratory Protection Newsletter*).

K. Paul Steinmeyer

1981 to 1986

Radiation Protection Specialist (Health Physics), Northeast Utilities, Berlin, Connecticut. Responsible for standardizing health physics equipment and procedures among three operating nuclear power units and one under construction. Coordinated medical emergency planning among the reactor plants, three hospitals, and several ambulance companies and fire departments. Oversaw the respiratory protection programs at the operating nuclear units. Performed health physics supervisor and technician training as required. Radiation Safety Officer.

1979 to 1981

Radiation Protection Specialist (Field Services), Northeast Utilities, Berlin, Connecticut. Supervised work activities of health physics technicians at three commercial nuclear power reactors during major refueling shutdowns. Researched, developed and wrote a compliance respiratory protection program for these reactor sites and assisted with the implementation of this program. Conducted training as required.

1976 to 1979

Health Physics Foreman, Connecticut Yankee Atomic Power Company, Haddam Neck, Connecticut. Responsible for supervising all aspects of the radiation protection program at this commercial nuclear power reactor, both during normal operations and when shut down for refueling and overhaul.

1975 to 1976

Health Physics Technician, Connecticut Yankee Atomic Power Company, Haddam Neck, Connecticut. Performed and evaluated all radiological surveys required. Collected samples and performed chemical analyses on reactor coolant and liquid waste.

PROFESSIONAL ACTIVITIES

President, Radiation Safety Associates, Inc.

Editor, *Radiation Protection Management*, the Journal of Applied Health Physics

Founder and Editor, *Respiratory Protection Newsletter*

K. Paul Steinmeyer

Registered Radiation Protection Technologist (NRRPT)

Faculty Member (Part Time), Industrial Technology Department, Central Connecticut State University

Member, Health Physics Society (National)

Member, Connecticut Chapter, Health Physics Society

Member, American Nuclear Society

PUBLISHED ARTICLES

"Radioactive Decay by Beta Particle Emission." *Radiation Protection Management*, 6 (January/February 1989): 60-63

"Calculating Exposure Rates from Known Quantities of Gamma-Emitting Radioisotopes." *Radiation Protection Management*, 6 (May/June 1989): 62-76.

"Beta Particle Shielding." *Radiation Protection Management*, 6 (July/August 1989): 71-76.

"Respiratory Protection Practices in the Nuclear Industry." *ECON; Environmental Contractor*, September 1989.

"Respirator Fit Testing and the Exercise Protocol." *Radiation Protection Management*, 6 (September/October 1989): 72-77.

Appendix A-2
Curriculum Vitae

RICHARD E. PERT

EDUCATION AND TRAINING

University of Lowell, Lowell, Massachusetts
Basic Radiological Health Physics Course, 1986

Northeastern University, Boston, Massachusetts
Computer Systems Specialist Course, 1984

University of Lowell, Lowell, Massachusetts--1976-80
Relevant courses included:

Biology	Physics, I, II, III
Chemistry	Calculus I, II, III
Statistics	Nuclear Instrumentation

National Environmental Training Association, Hartford, Connecticut
Environmental-Train-The-Trainer Course, 1990

EXPERIENCE

1989 to Present

Radiation Safety Associates, Inc., Hebron, Connecticut
Health Physicist. Responsible for service to clients as required by individual contracts. This includes performance of audits, writing license applications and amendments, maintaining radiological safety programs, providing technical advice, performing training.

Develop and conduct formal training courses including "Fundamentals of Radiation Protection," "Health Physics Technician Level I," "Radiation Safety Officer," "Radiation Safety for Industrial Hygienists," and "Hazardous Material Safety Training."

Write, edit, and develop course materials and technical articles. Research state and federal regulations having to do with radiation protection; packaging, surveying, labeling and shipping radioactive materials; and radioactive materials licensing.

Richard E. Pert

1988 to 1989

Amersham Corporation, Burlington, Massachusetts
Regulatory Affairs Technician. Performed audits, in-house training, maintained company and customer license files. Instructor for 40-hour radiation safety course for radiographers. Handled technical calls from customers about equipment, regulations and licensing information.

1986 to 1988

Genetics Institute, Cambridge, Massachusetts
Health and Safety Technician. Performed audits for radiation and biohazard safety compliance. Active in chemical safety including Right-to-Know program. Member of Radiation Safety Committee.

1980 to 1981

New England Nuclear Corporation, Boston, Massachusetts
Technologist. Performed personnel and laboratory surveys. Responsible for the bioassay and air sampling programs.

1978 to 1979

University of Lowell Nuclear Center, Lowell, Massachusetts
Assistant to Civil Defense Instructor. Calibrated instruments, set up fall-out maps, organized instructor's course material.

PROFESSIONAL ACTIVITIES

Health Physics Society
National Environmental Training Association

Appendix A-3
CURRICULUM VITAE

PAUL R. STEINMEYER

PROFESSIONAL ACTIVITIES

Health Physics Technician, Radiation Safety Associates, Inc.

Associate Editor, **Respiratory Protection Newsletter**

Contributing Author, **Radiation Protection Management**

Member, International Society for Respiratory Protection

EDUCATION AND TRAINING

"Respiratory Protection at Nuclear Facilities," Radiation Safety Associates, Inc.

"Health Physics Technician Level I," Radiation Safety Associates, Inc.

"Fundamentals of Radiation Protection," Radiation Safety Associates, Inc.

"Radon Measurement and Mitigation," CT Department of Health Services

"Reducing Indoor Radon," New York Department of Health Services

Attended University of Connecticut, School of Engineering

Attended Thames Valley State Technical College, Electrical Engineering Technology

Paul R. Steinmeyer

EXPERIENCE

1986 to present
Health Physics Technician, Radiation Safety Associates, Inc. Perform radiation and contamination surveys for various nuclear industry contacts. Perform quantitative and qualitative fit testing for various contracts. Associate Editor and Contributing Author, **Respiratory Protection Newsletter**. Contributing Author, **Radiation Protection Management**. Teach "Industrial Respiratory Protection" as well as respirator and fit testing-related segments of other short courses. Perform home radon inspections and consultation services.

PUBLISHED ARTICLES

"Suggested Standard Operating Procedure for the TSI PORTACOUNT." **Radiation Protection Management** 6: 5: pp. 28-38; Sep/Oct 1989. With Jeff Weed.

"Facial Hair Policy in a Respirator Program." **Radiation Protection Management** 6: 5: pp. 52-56; Sep/Oct 1989.

"Update on Contact Lens Use with Respirators--Status Report on Regulatory Position." **Respiratory Protection Newsletter** 5: 4: pp. 5-7; Jul/Aug 1989. With John Hale.

"Respiratory Protection Program Self-Audit Guide, Part Five." **Respiratory Protection Newsletter** 5: 5: pp. 1-4; Sep/Oct 1990.

"Respiratory Protection Program Self-Audit Guide, Part Six." **Respiratory Protection Newsletter** 5: 6: pp. 1-5; Nov/Dec 1989.

"1989 Conference of the International Society for Respiratory Protection." **Respiratory Protection Newsletter** 5: 6: pp. 7-9; Nov/Dec 1989.

"Permissible Exposure Limits and Protection Factors--Working Through the Maze." **Respiratory Protection Newsletter** 6: 1: pp. 1-5; Jan/Feb 1990.

"NRC Exemptions Allow Use of Sorbent Canisters against Radioiodine." **Respiratory Protection Newsletter** 6: 1: pp. 6-7; Jan/Feb 1990.

"The Word on the Streets." A regular column for the **Respiratory Protection Newsletter** Each issue since Jul/Aug 1989.

NUCLEAR INSTRUMENT CO.

Reg. No. 9617-1

Calibration Certificate

Customer Radiation Safety Associates Probe Type Internal-Scint.
Instrument Model Ludlum 19 Serial No. ~~~
Serial No. 32873 Calibration Date 7-23-90

Calibration source(s)	Radium 226 [A]	Radium 226 [B]	Radium 226 [C]	Cesium 137 [D]	Cesium 137 [E]
Quantity	25.02 mg.	4.98 mg.	1.03 mg.	130 curies	100 mCi.
Mfgs. No.	11880	1582	1-738	Model 69	28-5
NBS Traceable No.	TPX 33822	11005	11005	C-396	30214
Date	8-20-70	11-5-75	9-22-77	9-14-68	10-8-79

Calculated Exposure Rate (μR/hr)	Meter Reading	Range Maximum	Calibration Source[s]
3000	4550	5000 ~~MR/hr~~ μR/hr.	[E]
2000	3200	~~~ R/hr	
1000	1950		
500	515		
		_____ MR/hr	☐
		_____ R/hr	
		_____ MR/hr	☐
		_____ R/hr	
		_____ MR/hr	☐
		_____ R/hr	
		_____ MR/hr	☐
		_____ R/hr	

Integrate Calculated Dose

Beta Shield Open ☐ Closed ☐
Detector center axis parallel ☑ perpendicular ☐ to radiation field
Electronic Alignment ☑ Temperature_____ Barometric Pressure_____mm
Instrument check source: Scale:_____ Reading:_____
Remarks Electronic pulse calibrated per manufacturers procedure.
H.V. set @ 730 volts.

This instrument has been calibrated using procedures recommended by the N R.C
U.S. Nuclear Regulatory Commission U.S.N.R.C. License No 20-16972-01

Calibrated by Carl J Bonari

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Appendix B-2

REG.NO. 9617-1

NUCLEAR INSTRUMENT CO.
ROCKLAND, MASSACHUSETTS

CALIBRATION CERTIFICATE

Customer Radiation Safety Assoc. Probe Type 44-9 G.M.

Instrument Model Ludlum 18 Serial No. PR-017110

Serial No. 30723 Calibration Date 7-23-90

Calibration Source	Carbon-14
Quantity	.158 uCi
Mfgs. No.	NES-200A, Lot#200A080685
NBS Traceable No.	P.O.#34004
Date	8-6-85
Activity	347,600 DPM

Calibration: C-14 Source

C-14 on window contact = ------- CPM.
Efficiency = -------- %

C-14 on even plane with probe end = 21,500 CPM.
Efficiency = 6.18 %

C-14 @ 1cm distance from probe end = 11,800 CPM.
Efficiency = 3.4 %

Background, unshielded = 40 CPM.

High voltage set at 900 Volts (H.V. Position #1)

Electronic pulse calibration X

Comments:

Calibrated by Carl J Bossari U.S.NRC. License No. 20-16972-01

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NUCLEAR INSTRUMENT CO.
ROCKLAND, MASSACHUSETTS

CALIBRATION CERTIFICATE

Customer Radiation Safety Assoc Probe Type 44-9 G.M.

Instrument Model Ludlum 18 Serial No. PR-017110

Serial No. 30723 Calibration Date 7-23-90

Calibration Source	Strontium-90
Quantity	.0212 uCi.
Accuracy	+/- 3.2%
Mfgs. No.	NES-261 Lot #261031180A
NBS Traceable No.	SRM-4234-15, Aug., 1975
Date	3-11-80
Activity	72,180 DPM. 7-1-90 Date

Calibration:

Sr-90 on protective grid contact = ------- CPM.
Efficiency = ------- %

Sr-90 on even plane with probe end = 20,000 CPM.
Efficiency = 27.7 %

Sr-90 @ 1 cm distance from probe face = 12,100 CPM.
Efficiency = 16.76 %

Background, unshielded = 40 CPM.

High voltage set at 900 Volts (H.V. Position #1)

Electronic pulse calibration X

Comments: _____

Calibrated by Carl L Bossari U.S.NRC License No. 20-16972-01

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NUCLEAR INSTRUMENT CO.
ROCKLAND, MASSACHUSETTS

ALPHA CALIBRATION CERTIFICATE

Customer Radiation Safety Assoc. Probe Type 43-1 Scint.

Instrument Model Ludlum 18 Serial No. PR-021632

Serial No. 30723 Calibration Date 7-23-90

Calibration Sources	(A) Pu-239	(B) Pu-239	(C) Pu-239	(D) Pu-239
Particles/Min. (2Pi)	1,340	14,640	142,900	1,635,700
Disintigrations/Min. (4Pi)	2,640	28,840	281,500	3,222,300
Activity	.0012 uCi.	.0130 uCi.	.1269 uCi.	1.4533 uCi.
Mfgs, No.	2924	3937	3944	3959
Date	3-6-75	3-6-75	3-6-75	3-6-75

Source Attenuators: (1) SAP-1 (2) SAP-2

SOURCE: (2Pi)	DETECTED CPM.	RANGE MAXIMUM	EFFICIENCY	SOURCE	ATTN.
1,340	315	500	23.5	A	----
509	120	500	23.6	A	1
14,640	3,400	5,000	23.2	B	----
5,563	1,450	5,000	26.1	B	1
142,900	37,000	50,000	25.9	C	----
54,809	15,500	50,000	28.3	C	1

Background, unshielded --------- CPM.

High Voltage set at 900 Volts (H.V. Position #1)

Electronic Pulse Calibration X.

Comments: Condition : Calibration performed @ 1 cm distance from source.

Calibrated By Carl J Bonari U.S.NRC. License No. 20-16972-01

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NUCLEAR INSTRUMENT CO.
ROCKLAND, MASSACHUSETTS

ALPHA CALIBRATION CERTIFICATE

Customer Radiation Safety Assoc. Probe Type 43-1 Scint.

Instrument Model Ludlum 18 Serial No. PR-021632

Serial No. 30723 Calibration Date 7-23-90

Calibration Sources	(A) Pu-239	(B) Pu-239	(C) Pu-239	(D) Pu-239
Particles/Min. (2Pi)	1,340	14,640	142,900	1,635,700
Disintigrations/Min. (4Pi)	2,640	28,840	281,500	3,222,300
Activity	.0012 uCi.	.0130 uCi.	.1269 uCi.	1.4533 uCi.
Mfgs, No.	2924	3937	3944	3959
Date	3-6-75	3-6-75	3-6-75	3-6-75

Source Attenuators: (1) SAP-1 (2) SAP-2

SOURCE: (2Pi) (XXX	DETECTED CPM.	RANGE MAXIMUM	EFFICIENCY	SOURCE	ATTN.
621,566	340,000	500,000	54.7	D	----
310,783	155,000	500,000	49.9	D	1

Background, unshielded ------- CPM.

High Voltage set at 900 Volts

Electronic Pulse Calibration X

Comments:

Calibrated By Carl J Bosari U.S.NRC. License No. 20-16972-01

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Appendix B-4

REG.NO. 9617-1

NUCLEAR INSTRUMENT CO.
ROCKLAND, MASSACHUSETTS

CALIBRATION CERTIFICATE

Customer Radiation Safety Associates. Probe Type 44-3 Scint.

Instrument Model Ludlum 18 Serial No. PR-017111

Serial No. 30723 Calibration Date 7-23-90

Calibration Source	I-129
Quantity	.101 uCi (equiv. to .080 uCi, I-125)
Mfgs. No.	NES 9033
NBS Traceable No.	SRM-4949
Date	7-22-76
Activity	177,600 DPM.

Calibration:

I-129 on window contact= 50,000 CPM.
Efficiency = 28.1 %

I-129 on even plane with probe end = 40,500 CPM.
Efficiency = 22.8 %

I-129 @ 1cm distance from window = 19,400 CPM.
Efficiency = 10.9 %

Background ,unshielded = 350-420 CPM.

High voltage set at 830 Volts. (H.V. Position #2)

Electronic pulse calibration X

Instrument Check Source: Reading ---------
Range ---------

Comments:

Calibrated by Carl J Bowan U.S.NRC. Licence No. 20-16972-01

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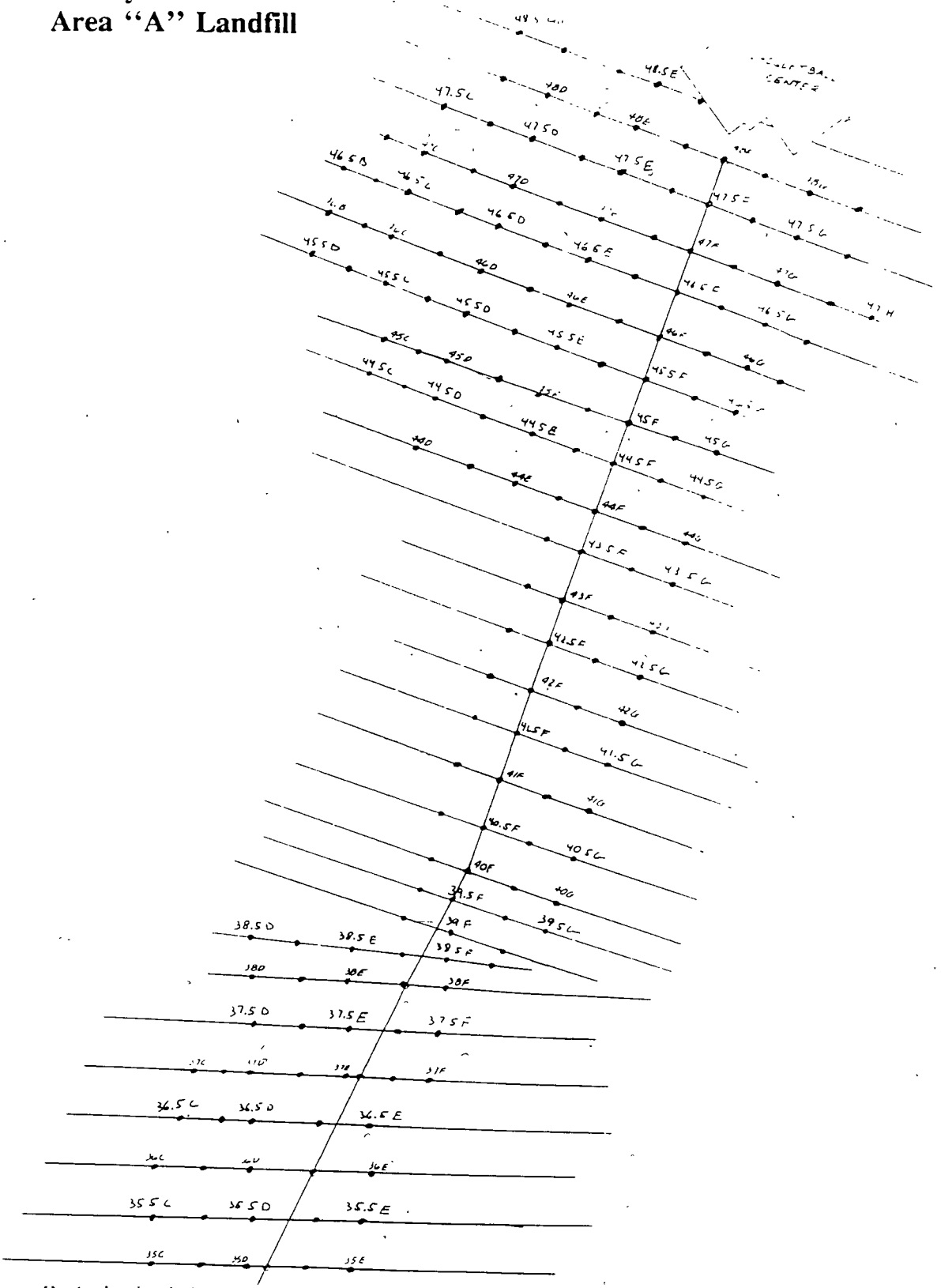
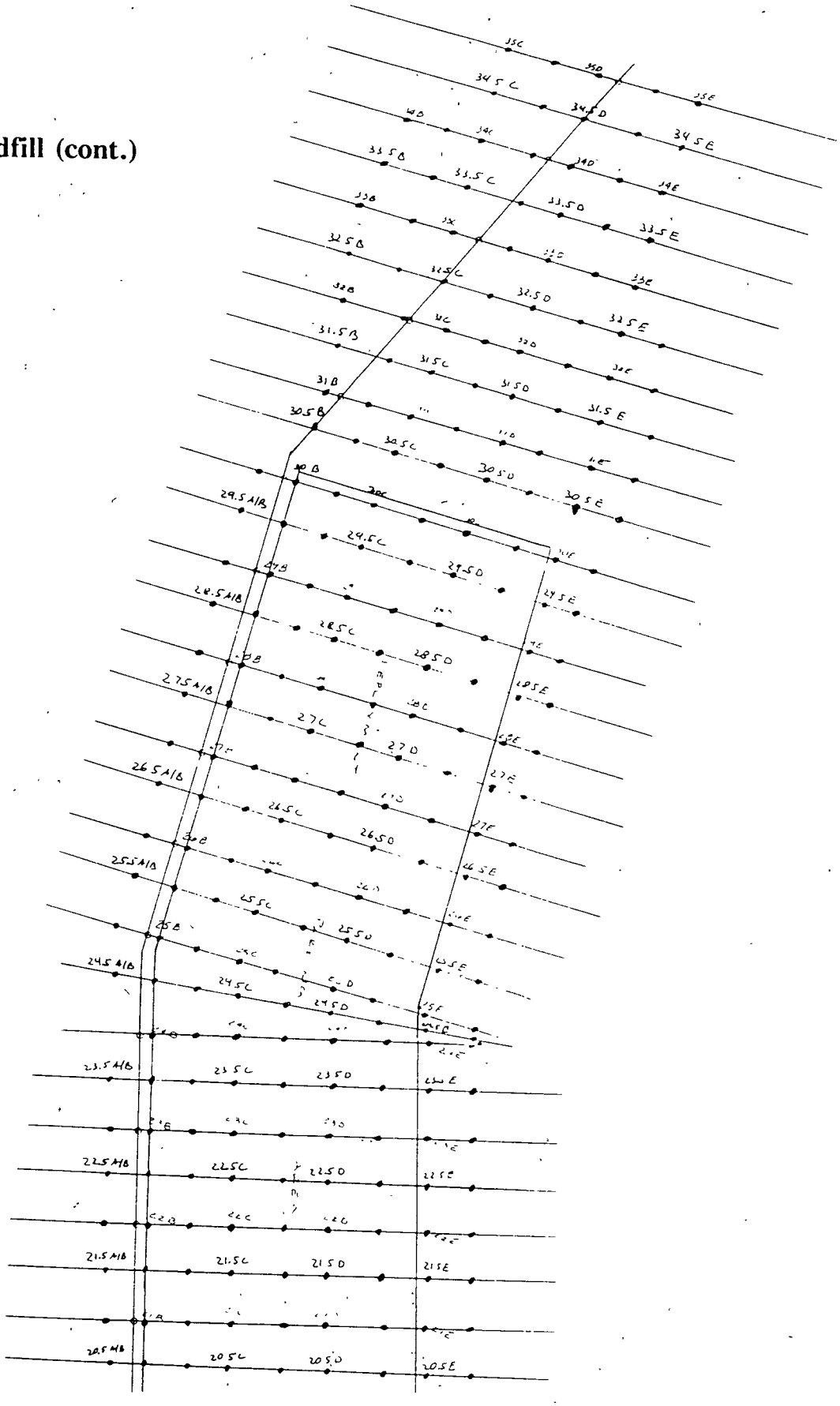
Appendix C-1

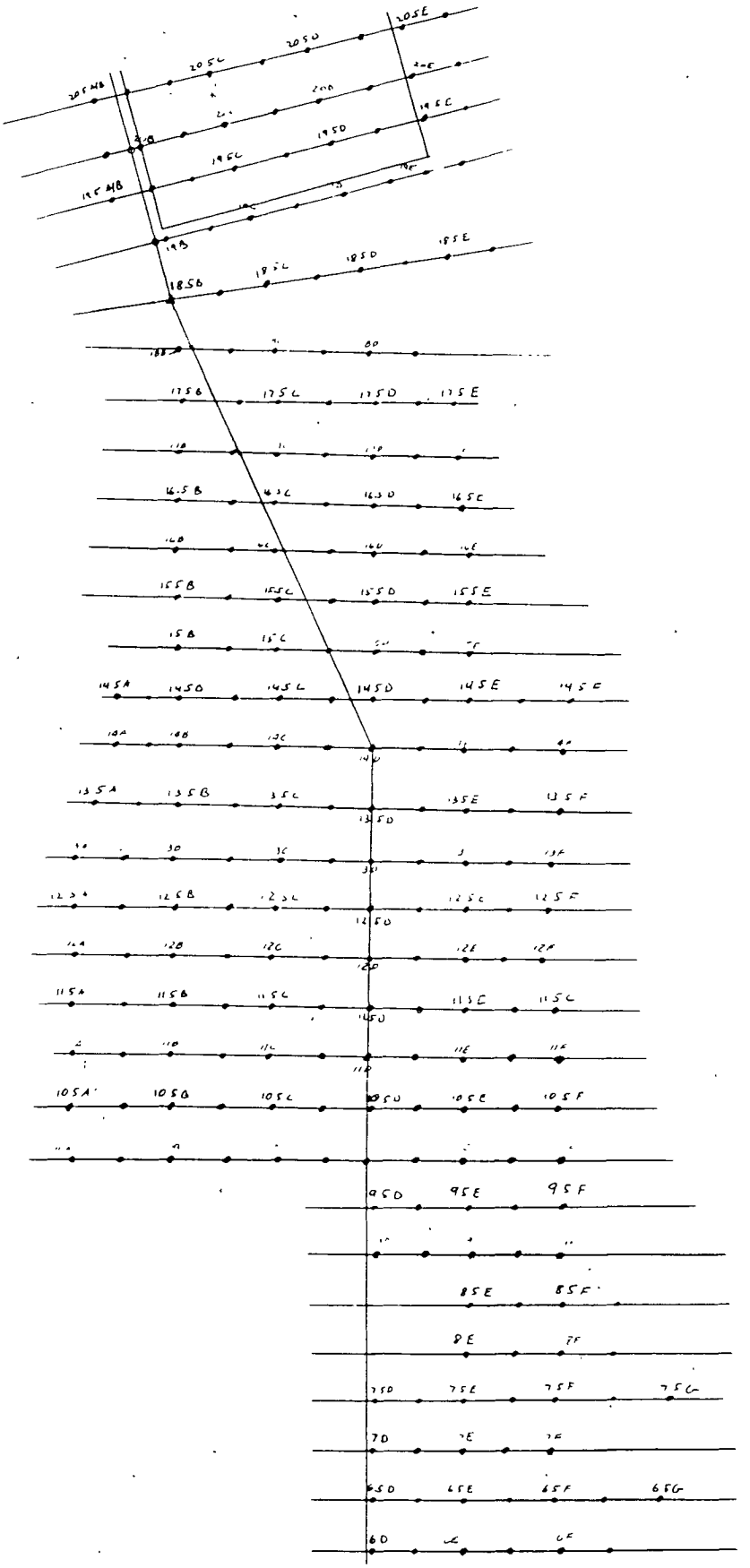
Survey Points
Area "A" Landfill



Survey Points
Area "A" Landfill (cont.)



Survey Points
Area "A" Landfill (cont.)



Appendix C-2

Area "A" Landfill

Gamma Activity

All readings in Micro Roentgens per hour (μR/hr)

For location of readings, refer to Survey Points Map (previous pages)

Location	Waist Level	Contact
6-D	N/A	N/A
6-D/E	N/A	N/A
6-E	13.5	12.5
6-E/F	13	13
6-F	13	13
6-F/G	15	16
6.5-D	N/A	N/A
6.5-D/E	N/A	N/A
6.5-E	12	12
6.5-E/F	12	14
6.5-F	13	13
6.5-F/G	15	16
6.5-G	14	14
7-D	N/A	N/A
7-D/E	N/A	N/A
7-E	12	13
7-E/F	13	13
7-F	14	15
7-F/G	16	17
7.5-D	N/A	N/A
7.5-D/E	11	13
7.5-E	12	13

Location	Waist Level	Contact
7.5-E/F	15	17
7.5-F	15	15
7.5-F/G	15	17
7.5-G	14	14
8-E	15	15
8-E/F	15	15
8-F	12.5	13
8-F/G	14	14
8.5-E	21	19
8.5-E/F	14	13
8.5-F	13	12
8.5-F/G	13	13
9-D	12.5	13
9-D/E	11	13
9-E	15	16
9-E/F	12	12
9-F	14	15
9.5-D	14	14
9.5-D/E	15	13
9.5-E	13	14
9.5-E/F	14	14
9.5-F	10	13

Location	Waist Level	Contact
10-A	13	13.5
10-A/B	12	11
10-B	11	12.5
10-B/C	10	11
10-C	11.5	12
10-C/D	13	14
10-D	12.5	13
10-D/E	12	12
10-E	12.5	13
10-E/F	14	13
10-F	13	12
10.5-A	12	13
10.5-A/B	12	12
10.5-B	12	13
10.5-B/C	13	12
10.5-C	11	13
10.5-C/D	12	15
10.5-D	13	14
10.5-D/E	12	12
10.5-E	11	17
10.5-E/F	10	14
10.5-F	14	15

Location	Waist Level	Contact
11-A	12	13.5
11-A/B	13	12
11-B	12.5	14
11-B/C	11	14
11-C	13	15
11-C/D	13	15
11-D	13	13
11-D/E	14	16
11-E	12	13
11-E/F	15	17
11-F	13	13
11.5-A	14	14
11.5-A/B	16	20
11.5-B	15	22
11.5-B/C	17	30
11.5-C	15	20
11.5-C/D	14	15
11.5-D	15	15
11.5-D/E	14	14
11.5-E	12	15
11.5-E/F	13	14
12-A	13	13.5
12-A/B	16	21
12-B	17	23
12-B/C	22	25
12-C	14	14.5

Location	Waist Level	Contact
12-C/D	14	13
12-D	14	14
12-D/E	15	12
12-E	12.5	13
12-E/F	8	12
12-F	12	12.5
12.5-A	14	15
12.5-A/B	14	15
12.5-B	14	23
12.5-B/C	15	18
12.5-C	13	18
12.5-C/D	15	15
12.5-D	15	17
12.5-D/E	12	15
12.5-E	8	12
12.5-E/F	12	13
12.5-F	13	14
13-A	14	14
13-A/B	13	15
13-B	15	16
13-B/C	17	17
13-C	16	19
13-C/D	15	14
13-D	11	13
13-D/E	12	13
13-E	12	12

Location	Waist Level	Contact
13-E/F	13	14
13-F	14	15
13.5-A	14	12
13.5-A/B	14	19
13.5-B	18	23
13.5-B/C	16	21
13.5-C	18	20
13.5-C/D	13	14
13.5-D	13	15
13.5-D/E	13	14
13.5-E	10	14
13.5-E/F	13	15
13.5-F	19	28
14-A	12.5	13
14-A/B	14	16
14-B	16	18
14-B/C	15	20
14-C	15	19
14-C/D	15	16
14-D	14	13.5
14-D/E	14	15
14-E	8	14
14-E/F	10	14
14-F	10	11
14.5-A	N/A	N/A
14.5-A/B	11	11

Location	Waist Level	Contact
14.5-B	12	12
14.5-B/C	14	13
14.5-C	12	13
14.5-C/D	13	15
14.5-D	15	14
14.5-D/E	13	14
14.5-E	13	14
14.5-E/F	13	10
14.5-F	9	12
15-A	13	13
15-A/B	N/A	N/A
15-B	12	12
15-B/C	N/A	N/A
15-C	13	15
15-C/D	N/A	N/A
15-D	15	13
15-D/E	14	15
15-E	12	12
15.5-C	15	16
15.5-C/D	N/A	N/A
15.5-D	15	14
15.5-D/E	14	14
15.5-E	15	15
16-B	12	14
16-B/C	13	13
16-C	12	14

Location	Waist Level	Contact
16-C/D	14	15
16-D	14	14
16-D/E	12	13
16-E	13	12
16.5-B	13	12
16.5-B/C	14	14
16.5-C	14	13
16.5-C/D	14	14
16.5-D	15	15
16.5-D/E	12	13
16.5-E	13	13
17-B	11	13
17-B/C	14	14
17-C	15	14
17-C/D	14	15
17-D	13	15
17-D/E	13	13
17-E	12	14
17.5-B	13	13
17.5-B/C	14	14
17.5-C	15	15
17.5-C/D	16	15
17.5-D	15	15
17.5-D/E	15	16
17.5-E	12	14
18-B	12	13

Location	Waist Level	Contact
18-B/C	14	15
18-C	14	14
18-C/D	14	14
18-D	13	14
18-D/E	15	15
18.5-B	12	12
18.5-B/C	13	15
18.5-C	13	14
18.5-C/D	15	14
18.5-D	13	15
18.5-D/E	13	14
18.5-E	15	16
19-B	12	13
19-B/C	12	15
19-C	12	13
19-C/D	11	12
19-D	11	13
19-D/E	13	15
19-E	15	13
19-E/F	14	15
19.5-A/B	13	13
19.5-B	13	15
19.5-B/C	12	12
19.5-C	10	12
19.5-C/D	9	12
19.5-D	12	10

Location	Waist Level	Contact
19.5-D/E	11	12
19.5-E	15	13
19.5-E/F	14	15
20-A/B	14	14
20-B	14	14
20-B/C	11	13
20-C	8	12
20-C/D	10	10
20-D	12	12
20-D/E	11	12
20-E	13	15
20-E/F	16	16
20.5-A/B	14	14
20.5-B	13	12
20.5-B/C	13	11
20.5-C	11	11
20.5-C/D	10	11
20.5-D	12	11
20.5-D\E	11	12
20.5-E	14	15
20.5-E/F	13	14
21-A/B	14	16
21-B	12	13
21-B/C	11	11
21-C	10	11
21-C/D	11	11

Location	Waist Level	Contact
21-D	9	10
21-D/E	10	12
21-E	11	13
21-E/F	13	15
21.5-A/B	14	16
21.5-B	11	10
21.5-B/C	12	11
21.5-C	10	9
21.5-C/D	10	11
21.5-D	13	12
21.5-D/E	13	13
21.5-E	13	12
21.5-E/F	14	15
22-A/B	13	13
22-B	12	11
22-B/C	10	10
22-C	10	10
22-C/D	9	9
22-D	9	11
22-D/E	10	12
22-E	14	13
22-E/F	15	14
22.5-A/B	14	15
22.5-B	12	12
22.5-B/C	11	13
22.5-C	12	11

Location	Waist Level	Contact
22.5-C/D	10	10
22.5-D	11	10
22.5-D/E	12	11
22.5-E	12	12
22.5-E/F	14	14
23-A/B	13	15
23-B	10	10
23-B/C	11	12
23-C	11	10
23-C/D	10	11
23-D	8	9
23-D/E	10	11
23-E	13	13
23-E/F	12	14
23.5-A/B	14	14
23.5-B	12	13
23.5-B/C	11	12
23.5-C	13	12
23.5-C/D	9	9
23.5-D	10	10
23.5-D/E	10	12
23.5-E	13	15
23.5-E/F	14	14
24-A/B	13	12
24-B	10	13
24-B/C	12	11

Location	Waist Level	Contact
24-C	9	9
24-C/D	9	10
24-D	9	10
24-D/E	11	11
24-E	11	13
24-E/F	14	14
24.5-A/B	13	12
24.5-B	11	12
24.5-B/C	11	10
24.5-C	9	10
24.5-C/D	12	12
24.5-D	11	12
24.5-D/E	11	11
24.5-E	12	13
24.5-E/F	14	15
25-A/B	13	14
25-B	11	13
25-B/C	11	11
25-C	10	10
25-C/D	9	10
25-D	8	8
25-D/E	12	12
25-E	12	14
25-E/F	15	15
25.5-A/B	13	15
25.5-B	12	14

Location	Waist Level	Contact
25.5-B/C	9	11
25.5-C	10	11
25.5-C/D	9	10
25.5-D	10	11
25.5-D/E	12	12
25.5-E	12	14
25.5-E/F	19	18
26-A/B	15	17
26-B	13	15
26-B/C	10	9
26-C	11	10
26-C/D	10	9
26-D	9	9
26-D/E	11	12
26-E	12	12
26-E/F	15	15
26.5-A/B	15	14
26.5-B	13	13
26.5-B/C	10	10
26.5-C	11	12
26.5-C/D	9	10
26.5-D	10	10
26.5-D/E	11	11
26.5-E	12	13
26.5-E/F	18	17
27-A/B	13	14

Location	Waist Level	Contact
27-B	12	10
27-B/C	11	10
27-C	11	13
27-C/D	10	10
27-D	8	9
27-D/E	12	12
27-E	13	14
27-E/F	20	19
27.5-A/B	13	13
27.5-B	12	13
27.5-B/C	9	10
27.5-C	10	11
27.5-C/D	10	11
27.5-D	12	11
27.5-D/E	10	11
27.5-E	13	15
27.5-E/F	17	17
28-A/B	12	14
28-B	13	12
28-B/C	10	10
28-C	8	8
28-C/D	8	8
28-D	10	11
28-D/E	11	11
28-E	15	14
28-E/F	19	18

Location	Waist Level	Contact
28.5-A/B	12	13
28.5-B	11	12
28.5-B/C	8	9
28.5-C	10	12
28.5-C/D	9	10
28.5-D	8	9
28.5-D/E	11	10
28.5-E	14	16
28.5-E/F	18	19
29-A/B	12	13
29-B	10	12
29-B/C	9	11
29-C	11	11
29-C/D	9	9
29-D	9	10
29-D/E	12	13
29-E	13	16
29-E/F	16	14
29.5-A/B	14	13
29.5-B	13	13
29.5-B/C	10	11
29.5-C	11	12
29.5-C/D	12	12
29.5-D	13	11
29.5-D/E	12	13
29.5-E	14	15

Location	Waist Level	Contact
29.5-E/F	14	13
30-A/B	13	13
30-B	11	11
30-B/C	10	10
30-C	9	11
30-C/D	8	12
30-D	11	12
30-D/E	11	12
30-E	12	13
30-E/F	13	13
30.5-B	13	14
30.5-B/C	13	12
30.5-C	14	15
30.5-C/D	12	11
30.5-D	13	13
30.5-D/E	14	13
30.5-E	13	13
30.5-E/F	15	15
31-B	12	12
31-B/C	13	13
31-C	10	13
31-C/D	12	12
31-D	11	12
31-D/E	13	13
31-E	12	13
31-E/F	14	17

Location	Waist Level	Contact
31.5-B	14	15
31.5-B/C	12	12
31.5-C	12	13
31.5-C/D	13	12
31.5-D	11	12
31.5-D/E	12	12
31.5-E	13	13
31.5-E/F	14	14
32-B	11	14
32-B/C	12	13
32-C	10	12
32-C/D	12	12
32-D	10	13
32-D/E	14	14
32-E	12	15
32-E/F	15	13
32.5-B	12	12
32.5-B/C	11	12
32.5-C	12	11
32.5-C/D	8	11
32.5-D	10	12
32.5-D/E	14	14
32.5-E	15	13
32.5-E/F	13	13
33-B	13	14
33-B/C	13	13

Location	Waist Level	Contact
33-C	13	12
33-C/D	12	13
33-D	10	11
33-D/E	12	14
33-E	15	16
33.5-B	13	15
33.5-B/C	12	15
33.5-C	13	13
33.5-C/D	12	11
33.5-D	11	13
33.5-D/E	12	13
33.5-E	14	15
34-B	13	16
34-B/C	14	13
34-C	13	12
34-C/D	11	13
34-D	10	12
34-D/E	13	12
34-E	12	14
34.5-C	12	13
34.5-C/D	13	12
34.5-D	12	14
34.5-D/E	14	13
34.5-E	14	13
35-C	13	12
35-C/D	10	12

Location	Waist Level	Contact
35-D	12	15
35-D/E	11	14
35-E	13	13
35.5-C	12	13
35.5-C/D	11	13
35.5-D	12	12
35.5-D/E	13	14
35.5-E	14	14
36-C	12	13
36-C/D	13	13
36-D	12	13
36-D/E	14	13
36-E	14	14
36.5-C	N/A	N/A
36.5-C/D	15	13
36.5-D	12	12
36.5-D/E	12	12
36.5-E	14	15
37-C	13	15
37-C/D	13	14
37-D	12	11
37-D/E	13	13
37-E	13	14
37-E/F	14	13
37-F	15	17
37.5-D	13	13

Location	Waist Level	Contact
37.5-D/E	12	11
37.5-E	15	14
37.5-E/F	16	16
37.5-F	14	17
38-D	N/A	N/A
38-D/E	15	13
38-E	13	13
38-E/F	14	15
38-F	13	13
38.5-D	N/A	N/A
38.5-D/E	N/A	N/A
38.5-E	N/A	N/A
38.5-E/F	12	11
38.5-F	12	12
38.5-F/G	13	13
39-E/F	12	13
39-F	12	12
39-F/G	11	10
39.5-E/F	14	16
39.5-F	11	12
39.5-F/G	13	12
39.5-G	12	12
40-E/F	15	15
40-F	11	11
40-F/G	11	13
40-G	13	14

Location	Waist Level	Contact
40.5-E/F	14	13
40.5-F	13	13
40.5-F/G	12	12
40.5-G	13	12
41-E/F	13	13
41-F	12	13
41-F/G	11	11
41-G	12	13
41.5-E/F	14	12
41.5-F	12	13
41.5-F/G	12	12
41.5-G	12	13
42-E/F	13	13
42-F	12	13
42-F/G	12	12
42-G	14	13
42.5-E/F	13	13
42.5-F	12	13
42.5-F/G	12	11
42.5-G	13	12
43-E/F	13	13
43-F	12	12
43-F/G	12	12
43-G	13	13
43.5-E/F	14	14
43.5-F	12	12

Location	Waist Level	Contact
43.5-F/G	12	13
43.5-G	13	13
44-D	14	13
44-D/E	14	14
44-E	13	14
44-E/F	13	13
44-F	12	13
44-F/G	12	12
44-G	13	13
44.5-C	N/A	N/A
44.5-C/D	N/A	N/A
44.5-D	15	15
44.5-D/E	14	15
44.5-E	14	14
44.5-E/F	13	13
44.5-F	13	12
44.5-F/G	13	13
44.5-G	12	13
45-C	14	14
45-C/D	14	15
45-D	14	15
45-D/E	13	13
45-E	13	13
45-E/F	14	13
45-F	12	13
45-F/G	12	12

Location	Waist Level	Contact
45-G	13	13
45.5-B	N/A	N/A
45.5-B/C	N/A	N/A
45.5-C	15	16
45.5-C/D	15	16
45.5-D	14	15
45.5-D/E	13	13
45.5-E	13	12
45.5-E/F	13	13
45.5-F	13	13
45.5-F/G	12	12
45.5-G	12	12
46-B	15	16
46-B/C	14	15
46-C	13	14
46-C/D	13	12
46-D	13	13
46-D/E	13	13
46-E	13	14
46-E/F	14	14
46-F	13	13
46-F/G	12	12
46-G	12	12
46-G/H	12	13
46.5-B	14	14
46.5-B/C	13	13

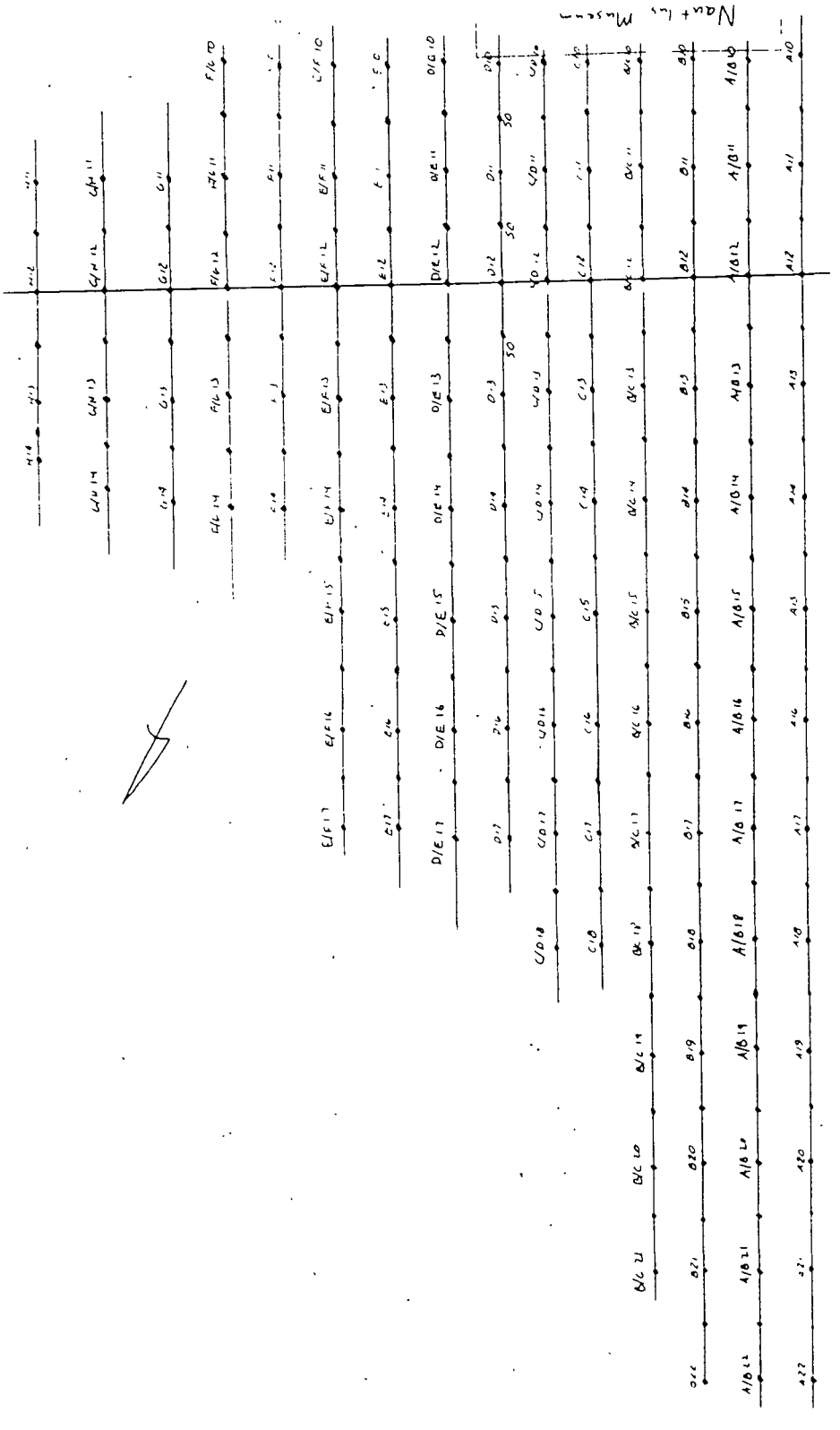
Location	Waist Level	Contact
46.5-C	14	14
46.5-C/D	13	13
46.5-D	13	14
46.5-D/E	12	12
46.5-E	12	12
46.5-E/F	12	12
46.5-F	12	13
46.5-F/G	13	13
46.5-G	12	12
46.5-G/H	13	13
47-B/C	13	13
47-C	13	14
47-C/D	13	13
47-D	13	13
47-D/E	13	13
47-E	14	13
47-E/F	13	13
47-F	14	15

Location	Waist Level	Contact
47-F/G	12	13
47-G	11	11
47-G/H	12	12
47-H	12	12
47.5-C	13	14
47.5-C/D	14	14
47.5-D	13	13
47.5-D/E	14	14
47.5-E	13	13
47.5-E/F	14	14
47.5-F	14	14
47.5-F/G	13	14
47.5-G	13	13
47.5-G/H	12	12
48-C/D	14	15
48-D	14	14
48-D/E	13	14
48-E	14	14

Location	Waist Level	Contact
48-E/F	15	15
48-F	14	14
48-F/G	14	14
48-G	13	13
48-G/H	13	12
48.5-C/D	N/A	N/A
48.5-D	13	14
48.5-D/E	14	14
48.5-E	15	15
48.5-E/F	15	16
48.5-F	N/A	N/A
48.5-F/G	N/A	N/A
48.5-G	N/A	N/A

Appendix D-1

Survey Points
Goss Cove



Appendix D-2

Goss Cove Landfill

Gamma Activity

All readings in Micro Roentgens per hour (μR/hr)

For location of readings, refer to Survey Points Map (previous page)

Location	Waist Level	Contact
A-10	10	10
A-10.5	8	10
A-11	10	10
A-11.5	11	10
A-12	10	11
A-12.5	11	13
A-13	10	11
A-13.5	11	12
A-14	11	12
A-14.5	11	12
A-15	13	12
A-15.5	12	12
A-16	12	12
A-16.5	12	11
A-17	10	11
A-17.5	12	12
A-18	13	13
A-18.5	12	13
A-19	12	12
A-19.5	11	12
A-20	11	12
A-20.5	11	12

Location	Waist Level	Contact
A-21	11	13
A-21.5	12	14
A-22	13	13
A/B-10	9	11
A/B-10.5	11	11
A/B-11	11	11
A/B-11.5	10	12
A/B-12	11	12
A/B-12.5	12	12
A/B-13	9	11
A/B-13.5	12	12
A/B-14	10	11
A/B-14.5	10	12
A/B-15	12	14
A/B-15.5	13	13
A/B-16	13	12
A/B-16.5	11	14
A/B-17	14	15
A/B-17.5	13	11
A/B-18	10	13
A/B-18.5	12	11
A/B-19	12	11

Location	Waist Level	Contact
A/B-19.5	12	13
A/B-20	13	12
A/B-20.5	12	14
A/B-21	14	14
A/B-21.5	13	12
A/B-22	12	12
B-10	9	16
B-10.5	10	12
B-11	10	11
B-11.5	10	11
B-12	10	10
B-12.5	10	14
B-13	12	13
B-13.5	12	13
B-14	12	12
B-14.5	11	15
B-15	13	12
B-15.5	12	13
B-16	12	12
B-16.5	12	14
B-17	11	13
B-17.5	12	13

Location	Waist Level	Contact
B-18	11	11
B-18.5	12	11
B-19	12	11
B-19.5	12	11
B-20	13	12
B-20.5	12	12
B-21	12	13
B-21.5	10	12
B-22	13	14
B/C-10	11	13
B/C-10.5	12	12
B/C-11	11	11
B/C-11.5	12	13
B/C-12	10	11
B/C-12.5	12	11
B/C-13	12	12
B/C-13.5	13	12
B/C-14	11	8
B/C-14.5	12	15
B/C-15	13	13
B/C-15.5	13	12
B/C-16	14	14
B/C-16.5	11	13
B/C-17	12	12
B/C-17.5	13	13
B/C-18	12	12

Location	Waist Level	Contact
B/C-18.5	12	11
B/C-19	13	15
B/C-19.5	14	15
B/C-20	13	15
B/C-20.5	14	14
B/C-21	13	12
C-10	9	10
C-10.5	10	11
C-11	11	11
C-11.5	10	10
C-12	11	11
C-12.5	12	13
C-13	12	13
C-13.5	13	13
C-14	12	13
C-14.5	13	13
C-15	13	14
C-15.5	14	15
C-16	13	14
C-16.5	12	12
C-17	12	12
C-17.5	12	12
C-18	13	14
C/D-10	10	11
C/D-10.5	10	12
C/D-11	11	11

Location	Waist Level	Contact
C/D-11.5	11	11
C/D-12	11	11
C/D-12.5	12	12
C/D-13	12	12
C/D-13.5	12	13
C/D-14	12	13
C/D-14.5	12	13
C/D-15	12	12
C/D-15.5	13	13
C/D-16	13	13
C/D-16.5	13	13
C/D-17	12	12
C/D-17.5	NA	NA
C/D-18	NA	NA
D-10	10	11
D-10.5	10	11
D-11	11	11
D-11.5	11	10
D-12	12	12
D-12.5	11	11
D-13	12	12
D-13.5	12	11
D-14	11	12
D-14.5	12	12
D-15	12	12
D-15.5	12	12

Location	Waist Level	Contact
D-16	13	13
D-16.5	13	13
D-17	12	12
D/E-10	11	11
D/E-10.5	11	12
D/E-11	10	8
D/E-11.5	11	12
D/E-12	11	12
D/E-12.5	12	13
D/E-13	12	13
D/E-13.5	13	12
D/E-14	12	13
D/E-14.5	14	13
D/E-15	13	13
D/E-15.5	13	13
D/E-16	13	14
D/E-16.5	15	15
D/E-17	14	15
E-10	11	10
E-10.5	11	11
E-11	10	10
E-11.5	12	11
E-12	12	13
E-12.5	12	12
E-13	12	12
E-13.5	13	12

Location	Waist Level	Contact
E-14	12	13
E-14.5	12	12
E-15	13	13
E-15.5	14	14
E-16	13	14
E-16.5	14	15
E-17	15	15
E/F-10	11	11
E/F-10.5	12	13
E/F-11	13	13
E/F-11.5	12	12
E/F-12	12	12
E/F-12.5	12	13
E/F-13	13	13
E/F-13.5	12	13
E/F-14	13	13
E/F-14.5	14	14
E/F-15	15	15
E/F-15.5	15	16
E/F-16	15	15
E/F-16.5	15	16
E/F-17	15	15
F-10	13	12
F-10.5	12	12
F-11	12	13
F-11.5	12	11

Location	Waist Level	Contact
F-12	12	13
F-12.5	13	13
F-13	13	13
F-13.5	14	13
F-14	16	16
F/G-10	13	12
F/G-10.5	13	13
F/G-11	13	14
F/G-11.5	13	13
F/G-12	13	13
F/G-12.5	13	13
F/G-13	14	14
F/G-13.5	14	14
F/G-14	16	19
G-11	13	13
G-11.5	12	12
G-12	12	13
G-12.5	14	14
G-13	14	15
G-13.5	15	16
G-14	16	16
G/H-11	14	14
G/H-11.5	13	13
G/H-12	13	13
G/H-12.5	14	13
G/H-13	14	14

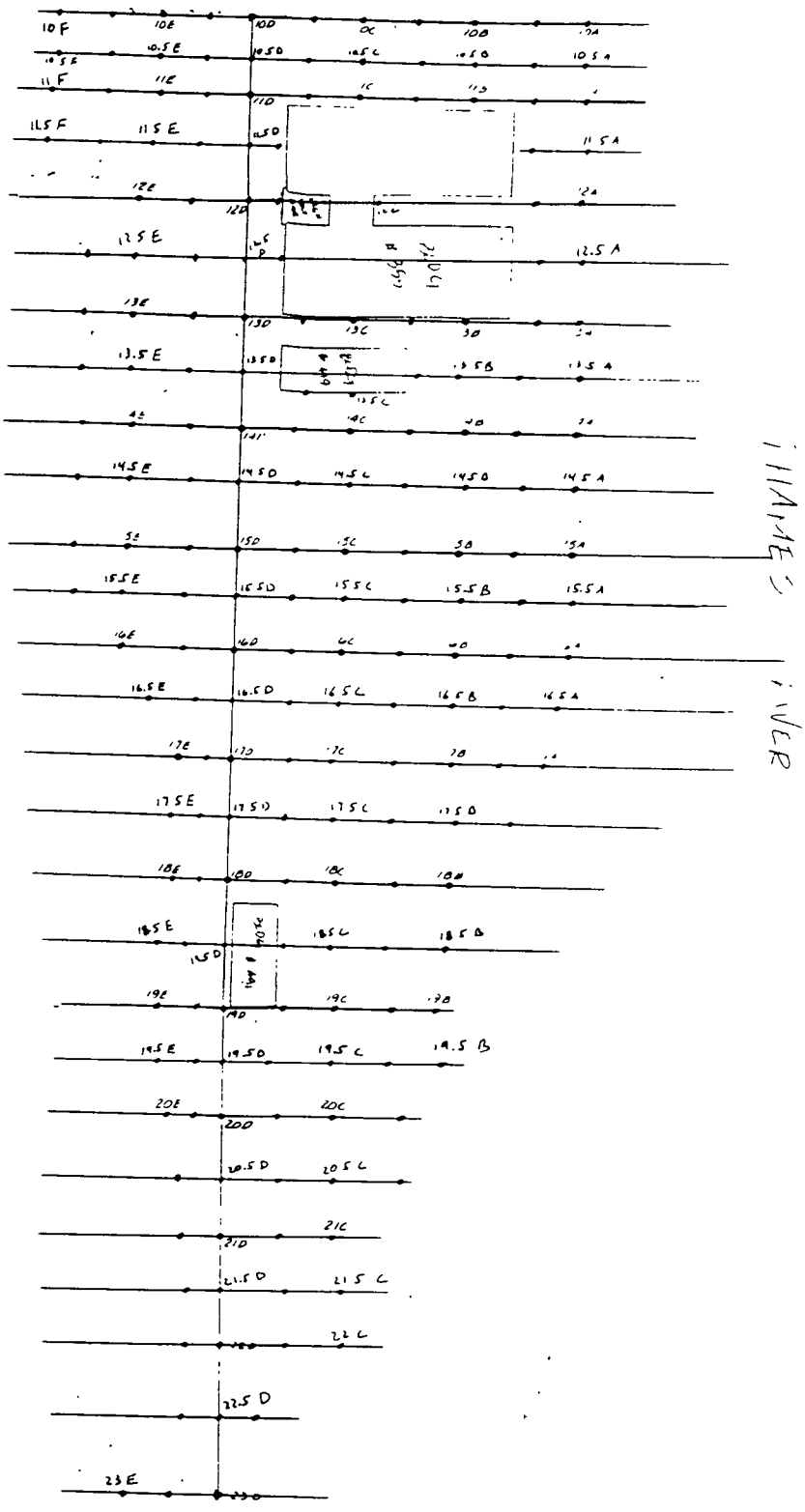
Location	Waist Level	Contact
G/H-13.5	15	15
G/H-14	16	16
H-11	14	15
H-11.5	13	13
H-12	12	13

Location	Waist Level	Contact
H-12.5	13	14
H-13	15	14
H-13.5	15	15
H-14	16	17

Location	Waist Level	Contact

Survey Points
DPDO

Appendix E-1



Appendix E-2
DRMO

Gamma Activity
All readings in Micro Roentgens per hour (μR/hr)
For location of readings, refer to Survey Points Map (previous pages)

Location	Waist Level	Contact
10-A	12	13
10-A/B	12	12
10-B	11	11
10-B/C	10	12
10-C	11	10
10-C/D	13	13
10-D	13	14
10-D/E	13	15
10-E	13	14
10-E/F	12	13
10-F	15	13
10.5-A	9	11
10.5-A/B	10	10
10.5-B	11	12
10.5-B/C	11	12
10.5-C	12	12
10.5-C/D	11	12
10.5-D	13	13
10.5-D/E	13	12
10.5-E	12	12
10.5-E/F	17	15
10.5-F	14	12

Location	Waist Level	Contact
11-A	11	13
11-A/B	12	11
11-B	10	12
11-B/C	12	11
11-C	12	13
11-C/D	12	13
11-D	13	13
11-D/E	12	12
11-E	12	12
11-E/F	15	15
11-F	14	15
11.5-A	12	12
11.5-A/B	11	12
11.5-B	N/A	N/A
11.5-B/C	N/A	N/A
11.5-C	12	15
11.5-C/D	13	15
11.5-D	16	17
11.5-D/E	13	13
11.5-E	12	10
11.5-E/F	14	14
11.5-F	14	14

Location	Waist Level	Contact
12-A	11	11
12-A/B	12	12
12-B	N/A	N/A
12-B/C	N/A	N/A
12-C	13	12
12-C/D	12	14
12-D	16	15
12-D/E	15	14
12-E	14	15
12-E/F	13	14
12-F	13	16
12.5-A	11	11
12.5-A/B	12	15
12.5-B	N/A	N/A
12.5-B/C	N/A	N/A
12.5-C	10	12
12.5-C/D	11	12
12.5-D	14	15
12.5-D/E	14	13
12.5-E	15	16
12.5-E/F	13	14
12.5-F	N/A	N/A

Location	Waist Level	Contact
13-A	15	13
13-A/B	13	15
13-B	11	13
13-B/C	13	12
13-C	12	14
13-C/D	12	14
13-D	14	13
13-D/E	15	13
13-E	12	13
13-E/F	N/A	N/A
13-F	N/A	N/A
13.5-A	12	13
13.5-A/B	13	13
13.5-B	15	15
13.5-B/C	11	13
13.5-C	14	15
13.5-C/D	12	13
13.5-D	14	14
13.5-D/E	13	13
13.5-E	12	13
13.5-E/F	15	15
14-A	16	16
14-A/B	11	9
14-B	12	13
14-B/C	14	14
14-C	15	14

Location	Waist Level	Contact
14-C/D	14	15
14-D	14	13
14-D/E	14	15
14-E	13	14
14-E/F	15	17
14.5-A	12	13
14.5-A/B	11	14
14.5-B	11	13
14.5-B/C	11	13
14.5-C	12	14
14.5-C/D	13	16
14.5-D	15	14
14.5-D/E	15	15
14.5-E	14	13
14.5-E/F	15	17
15-A	13	14
15-A/B	10	12
15-B	12	14
15-B/C	10	16
15-C	13	15
15-C/D	14	14
15-D	15	15
15-D/E	14	14
15-E	13	15
15-E/F	16	16
15.5-A	11	12

Location	Waist Level	Contact
15.5-A/B	12	12
15.5-B	13	17
15.5-B/C	12	15
15.5-C	14	14
15.5-C/D	15	15
15.5-D	13	14
15.5-D/E	16	15
15.5-E	14	14
15.5-E/F	14	15
16-A	12	12
16-A/B	11	13
16-B	12	13
16-B/C	13	14
16-C	14	15
16-C/D	14	15
16-D	15	15
16-D/E	13	15
16-E	12	16
16-E/F	N/A	N/A
16.5-A	11	12
16.5-A/B	13	14
16.5-B	N/A	N/A
16.5-B/C	N/A	N/A
16.5-C	12	12
16.5-C/D	12	13
16.5-D	13	16

Location	Waist Level	Contact
16.5-D/E	14	14
16.5-E	13	14
17-A	10	12
17-A/B	12	13
17-B	12	12
17-B/C	N/A	N/A
17-C	12	11
17-C/D	13	13
17-D	13	13
17-D/E	12	14
17-E	14	15
17.5-A/B	11	12
17.5-B	12	12
17.5-B/C	9	12
17.5-C	11	13
17.5-C/D	12	13
17.5-D	12	11
17.5-D/E	12	12
17.5-E	14	15
18-A/B	12	13
18-B	13	13
18-B/C	10	12
18-C	14	13
18-C/D	12	13
18-D	15	14

Location	Waist Level	Contact
18-D/E	13	15
18-E	12	14
18.5-B	12	10
18.5-B/C	11	11
18.5-C	11	13
18.5-C/D	12	14
18.5-D	13	13
18.5-D/E	13	13
18.5-E	12	12
19-B	11	11
19-B/C	10	12
19-C	12	12
19-C/D	13	14
19-D	14	15
19-D/E	13	13
19-E	14	12
19.5-B	12	14
19.5-B/C	12	13
19.5-C	12	12
19.5-C/D	10	11
19.5-D	12	12
19.5-D/E	10	12
19.5-E	12	15
20-B/C	10	11
20-C	12	12

Location	Waist Level	Contact
20-C/D	12	12
20-D	15	14
20-D/E	13	13
20-E	12	10
20.5-B/C	10	12
20.5-C	11	12
20.5-C/D	10	12
20.5-D	13	13
20.5-D/E	14	13
21-C	10	9
21-C/D	12	12
21-D	12	11
21-D/E	13	13
21.5-C	10	10
21.5-C/D	11	10
21.5-D	12	12
21.5-D/E	12	13
22-C	12	12
22-C/D	10	11
22-D	12	11
22-D/E	14	14
22.5-C/D	10	11
22.5-D	12	12
22.5-D/E	14	15
23-D	11	12

Location	Waist Level	Contact
23-D/E	12	13
23-E	13	13

Location	Waist Level	Contact

Location	Waist Level	Contact

the NDL Organization, inc.

post office box 791
peekskill, new york 10566
(914) 737-7200

09/12/90

RICHARD E. PERT
HEALTH PHYSICIST
RADIATION SAFETY ASSOCIATES,INC.
10 PENDLETON DRIVE
HEBRON,CT 06248

DEAR DOCTOR,

YOUR 1 SAMPLE (environmental) WAS COUNTED OVER THE TECHNICAL ASSOCIATES MST-30 GAS FLOW PROPORTIONAL COUNTER FOR 1 MINUTES OVER THE ALPHA PLATEAU .THE NE COUNT WAS IN THE RANGE 0 TO 3 CPM.,2 SD OR 95% CONFIDENCE LEVEL
THE LLD AT THE 95% CONFIDENCE INTERVAL = 4.66*SQRT(R/BG) T/BG))=3.9 PCI 88.2

WHERE
LLD= LOWER LIMIT OF DETECTION
HEALTH &SAFETY LABORATORY,NRC- NEW YORK
'DEFINES THE LOWER LIMIT OF DETECTION'LLD AS THE SMALLEST AMOUNT OF SAMPLE ACTIVITY THAT WILL YIELD A NET COUNT FOR WHICH THERE IS A CONFIDENCE AT THE PREDETERMINED LEVEL FOR ACTIVITY BEING PRESENT NORMALLY THE 95% CONFIDENCE LEVEL IS USED
R(BG)= RATE OF BACKGROUND(CT/MIN)
T(BG)= TIME OF BACKGROUND(MIN)

SINCE THE NET COUNT (LLD 3 CPM),THEN THE SAMPLE WAS NOT CONTAMINATED,IE IT BACKGROUND.

YOUR GAMMA ANALYSIS FOR 401 GM OF SAMPLE WAS COUNTED OVER THE HIGH PURITY GERMANIUM 20% EFFICIENCY DETECTOR FOR 60 MINUTES .NO UNUSUAL PEAKS WERE DETECTED THAT WERE NOT BACKGROUND.THE PEAK SEARCH REPORT & THE FINAL ACTIVITY REPORT WERE ACCOMPANYING THIS SUMMARY REPORT.

THANK YOU DOCTOR FOR YOUR TIME.IF YOU HAVE ANY QUESTIONS PLEASE DON'T HESITATE TO CALL 914-737-7200.

David Lam

DAVID LAM

The NDL Organization, Inc.

Quantum Technology
GDR_C Version 5.0

Sample ID : 91090 rsa sample

Sample Size	4.01e+002 g	Spectrum File	.TEMP.SP
Sampling Start.	09-10-90 06:57	Counting Start.	09-10-90 06:
Sampling Stop	09-10-90 06:57	Live Time	3567 3
Current Date.	09-12-90 05:12	Real Time	3600 3

Detector #: 8

Energy(keV)= -2.70 + 0.315*Ch + 4.67e-007*Ch^2 +-3.65e-011*Ch^3 08-18-90 07:0

FWHM(keV) = 1.42 + 0.024*En + 0.00e+000*En^2 + 0.00e+000*En^3 08-18-90 07:0
Where En = Sqrt(Energy in keV)

Sensitivity	1.00	Search Start End.	150 31
Sigma Multiplier.	1.00		

PEAK SEARCH RESULTS

Pk. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UNCERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM keV	FLAG
1	74.66	245.23	417	74	142	1345	1.87	a
2	77.09	252.95	335	60	111	1000	1.76	b
3	186.03	598.01	132	56	109	873	2.32	
4	238.80	765.02	310	51	97	601	1.50	a
5	242.31	776.13	167	42	79	470	1.33	b
6	295.37	944.01	362	47	87	465	1.68	
7	338.91	1091.73	98	39	75	363	2.06	
8	352.03	1133.20	586	44	73	349	1.39	
9	510.49	1624.01	307	36	68	282	2.38	
10	583.05	1853.17	139	30	57	190	0.96	
11	609.32	1936.11	438	35	57	201	1.90	
12	911.31	2888.93	142	25	45	123	1.55	
13	969.44	3072.20	45	22	41	98	1.66	
14	1120.54	3548.51	150	22	38	86	1.19	
15	1173.32	3714.87	63	21	41	88	2.17	
16	1461.01	4621.46	543	32	45	109	2.80	
17	1764.11	5576.88	127	17	26	33	2.31	

The NDL Organization, Inc.

Quantum Technology
GDR_C Nuclide Activity Summary

Sample ID: 91090 rsa sample

Sample Size	4.01e+002 g	Spectrum File	.TEMP.S
Sampling Start. . . .	.09-10-90 06:57	Counting Start.	09-10-90 06:
Sampling Stop	.09-10-90 06:57	Buildup Time.	0.00e+000 H
Current Date.	.09-12-90 05:13	Decay Time (OFF). . . .	0.00e+000 H
Efficiency File.	.ndlcal5.eff	Library File.	.FUEL.L
ID.	.500 ml on hpge	ID. NUC FUEL/ORNL/NUREG-TM-102 +NATUR

Eff.= 1/[9.10e-001*En^-1.57e+000 + 2.33e+002*En^9.29e-001] 08-18-90 06:

Gamma Fraction Limit >= . . . 60.00 % | Decay Limit <=. . . . 8.000 Halfli

FINAL ACTIVITY REPORT

Nuclide	Energy (keV)	Conc +- 1.00sigma (pCi/g)	Halflife (hrs)	Peaks Found	MPC Fractio
Pb-214	Average:	2.91e+000 +-1.32e-001	1.40e+007	6 of 16	0.0
	242.00	2.98e+000 +-7.55e-001			
	295.20	2.89e+000 +-3.76e-001			
	351.90	2.77e+000 +-2.07e-001			
	609.30	2.66e+000 +-2.14e-001			
	1120.30	5.07e+000 +-7.60e-001			
	1764.50	6.00e+000 +-7.92e-001			
Tl-208	Average:	4.47e-001 +-9.47e-002	1.23e+014	3 of 11	0.0
	75.00	4.50e-001 +-3.03e+000			
	510.80	4.46e-001 +-4.06e-001			
	583.10	4.47e-001 +-9.74e-002			
Pb-212	Average:	1.08e+000 +-1.43e-001	1.23e+014	3 of 12	0.0
	74.81	9.19e-001 +-9.72e-001			
	77.11	2.54e+000 +-4.56e-001			
	238.60	9.22e-001 +-1.53e-001			
U-235+D	185.70	2.85e-001 +-1.21e-001	6.22e+012	1 of 3	
Ra-226	Average:	2.69e+000 +-2.13e-001	1.40e+007	2 of 2	0.0
	186.00	4.68e+000 +-1.99e+000			
	609.30	2.66e+000 +-2.14e-001			
ANN	511.00	I.D.Only	1.00e+012	1 of 1	
Ac-228	911.10	2.08e+000 +-3.67e-001	1.23e+014	1 of 1	
K-40	1460.81	3.40e+000 +-2.01e-001	9.00e+009	1 of 1	
Th-232+D	911.10	2.17e+000 LTL	1.23e+014		
U-238+D	63.29	6.18e+000 LTL	3.94e+013		
	92.60	5.87e+000 LTL			
	1001.00	3.92e+001 LTL			
Th-228+D	241.00	1.70e+001 LTL	1.23e+014		
TOTAL:		1.29e+001 pCi/g		MPC Total:	0.0

UNKNOWN PEAKS

Energy (keV)	Centroid Channel	Net Counts	Un-Certainty	C.L. Counts	Big. Counts	FWHM (keV)	Net Gamma/sec
338.91	1081.73	98	39	75	363	2.06	2.479e+000
969.44	3072.20	95	22	41	98	1.66	6.052e+000
1173.32	3714.87	63	21	41	88	2.17	4.784e+000

```
**********************************
*******    gfpc-alpha  ***********
**********************************
09-12-1990     05:16:54
SOURCE COUNT= 8640                    mass sample = 20 gm.
TIME        = 1
ACTIVITY(DPM= 9200

EFFICIENCY= .9391304
bg rate(cpm)= 3
time bg(min)= 1
lld cr  = 8.071356
lld dpm= 8.594499
lld pci= 3.906591
SAMPLE## CPM                  # DPM                  ACTIVITY(PCI)
  1   0 +/- 3                   0 +/- 1.344313       0 +/- 1      /20 g
```